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⑯ Television tuner.

⑯ The present invention relates to a television tuner capable of receiving television broadcasting, CATV and satellite broadcasting. The television tuner includes a double superheterodyne tuner for receiving television signals, having an up-converter (40), a down-converter (42) and a coupler (41) for coupling the up-converter and down-converter, and the television tuner also includes a BS second mixer portion (40) and a FM demodulator (43), for receiving signals from a broadcasting satellite. The double superheterodyne tuner, the BS second mixer portion and the FM demodulator are disposed in a housing (74), a combination of the up-converter and the BS second mixer portion is undesirably separated from the down-converter, the coupler is disposed in a space between the combination and the down-converter, and the FM demodulator is disposed in the remaining space of the housing.

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## TELEVISION TUNER

## BACKGROUND OF THE INVENTION

## FIELD OF THE INVENTION

The present invention relates to a television tuner and in particular to a television tuner which is capable of receiving general television broadcasting, CATV, and satellite broadcasting.

## DESCRIPTION OF THE RELATED ART

Recently, an advance in audio and visual technology has been drastic. An increase in the number of the broadcasting channels and a further improvement in picture quality have been demanded. A development for providing more compact satellite broadcasting receiving systems and for incorporating the satellite broadcasting receiving system into a television system has become more active.

It is advantageous to adopt a double superheterodyne system for a TV tuner in consideration of multi-channel reception and necessary band pass characteristics for each channel.

Now conventional double superheterodyne type television tuner will be described with reference to the drawings.

Referring now to Fig. 1, there is shown the structure of a conventional double superheterodyne type television tuner. In Fig. 1, reference numerals 1 through 3 denote input band pass filters, each having different frequency characteristics; reference numeral 4 denotes a broad band amplifier (RF amplifier); 5 denotes a first mixer; 6 denotes a first local oscillator; 7 denotes a first intermediate frequency (IF) amplifier; 8 a band pass filter (BPF); 9 a second mixer; 10 a second local oscillator; 11 a second IF amplifier and 14 a prescaler.

The operation of the thus formed tuner shown in Fig. 1 will now be described. A high-frequency signal is inputted into the input band pass filters 1, 2, and 3 provided for each band (for example VHF, CATV and UHF) through a terminal A. The signal which has passed through the filters 1, 2 and 3 is amplified by the broad band amplifier 4 and is then inputted to the first mixer 5. The signal is mixed with an oscillation signal from the first local oscillator 6 in the first mixer 5 from which a signal having a difference component therebetween is outputted as a first IF signal. The IF signal is then amplified. Only the first IF signal is selected by the band pass filter 8 and is then inputted to the second mixer 9 in which the inputted signal is mixed with a

second oscillation signal from the second local oscillator 10. A signal having a difference component is outputted from the second mixer 9 as a second IF signal. The second IF signal is inputted to a terminal B through the second IF amplifier 11. The first local oscillator 6 is supplied with a local oscillation tuning voltage. The local oscillation signal from the first local oscillator 6 is frequency-divided by the prescaler 14 from which the frequency-divided output is fed to a channel selector circuit (not shown) from a terminal E.

In the afore-mentioned arrangement, any one of the first IF amplifier 7 and the band pass filter 8 may be preceded by the other according to the design.

The first half of the tuner before the band pass filter 8 in Fig. 1 will be referred to as an up-converter meaning a portion which converts the inputted signal frequency into an IF frequency higher than the inputted signal frequency. The latter half of the tuner after the band pass filter 8 in Fig. 1 is referred to as a down-converter meaning a portion which converts the first IF signal frequency into a second IF frequency lower than the first IF frequency.

A conventional example of a satellite broadcasting receiving tuner (referred to as a BS tuner) will be described with reference to Figs. 2 and 3. Fig. 2 shows a portion of the BS tuner referred to as a BS second mixer portion comprising an input filter 21, a BS first IF amplifier 22, a mixer 23, a local oscillator 24, a BS second IF amplifier 25, and a prescaler 26. Fig. 3 shows a FM demodulator for the BS tuner comprising a BS second IF amplifier 30, a band pass filter 31, another BS second IF amplifier 32, a phase comparator 33, a loop filter 34, a direct current amplifier 35, a base band amplifier 36, and an oscillator 37.

The operation of the thus formed mixer and FM demodulator shown in Figs. 2 and 3 will be described. In Fig. 2, a signal from a broadcasting satellite (1.0 to 1.3 GHz) is block-converted into the first intermediate frequency (referred to as BSIF) at a pre-stage, and the converted signal is inputted into a terminal C. The band pass filter 21 passes only a BSIF and inputs the BSIF signal to the mixer 23 through the BS first IF amplifier 22. The BSIF signal is mixed at the mixer 23 with an inputted signal from the local oscillator 24. The mixer 23 outputs a difference signal as a BS second IF signal having a 403 MHz to a terminal D through the BS second IF amplifier 25. A tuning voltage is applied to the local oscillator 24 from a terminal F and the local oscillation signal is also applied to the prescaler 26 from the local oscillator 24. The ap-

plied signal is frequency-divided and applied to a channel selection circuit (not shown) from the terminal E.

The BS second IF signal which has been inputted to the terminal D is then inputted to a terminal E in Fig. 3 and amplified in the BS second IF amplifier 30 and is passed through the 400 MHz band pass filter 31 and then inputted into a FM demodulator through the BS second IF amplifier 32. The FM demodulator comprises a phase comparator 33, a loop filter 34, a direct current amplifier 35, and an oscillator 37 which form a phase-locked loop (PLL) for PLL detection. FM demodulated output from the FM demodulator is inputted to the base band amplifier 36 which provides an amplified demodulated signal to a terminal F.

A conventional example of the structure of a double superheterodyne tuner will be described with reference to Figs. 4A, 4B and 5. Figs. 4A and 4B show an arrangement of a housing for a double superheterodyne tuner and a satellite broadcasting receiving tuner, respectively. Fig. 4A shows an arrangement of the double superheterodyne tuner shown in Fig. 1 comprising an up-converter 50, an up- and down-converter coupling filter 51, a down-converter 52 and an antenna input terminal for VHF and UHF signals. Fig. 4B shows an arrangement of a satellite broadcasting receiving tuner shown in Fig. 2 comprising a BS second mixer portion 54, a FM demodulator 55 and a BSIF input terminal 56.

Fig. 5 shows the up- and down-converter coupling filter (up- and down-converter coupler) 51 forming a low pass filter comprising feed-through type capacitors 61 and 62 disposed on the up- and down-converter sides, respectively and a air-cored coil 63. On the both sides of the up- and down-converter coupling filter 51, there are disposed circuit boards 64 and 65 with respective shield plates 66 and 67 for up- and down-converters. The air-cored coil 63 is disposed in a space between the shield plates 66 and 67. The opposite ends of the air-cored coil 63 are soldered to the leads of the feed-through type capacitors 61 and 62 secured to the shield plates 66 and 67, respectively to form the filter. The purpose of the shield plates and the low pass filter is to prevent spurious signals from generating at the down-converter output due to an interference between the local oscillation signals in the up- and down-converters.

In order to provide a tuner which is capable of receiving both of general television signal and satellite broadcast signal, it is necessary to provide separate housings shown in Figs. 4A and 4B and to provide a space for a filter like the filter 51 in the television tuner as shown in Fig. 4A to prevent spurious radiation from generating. A configuration like this makes it difficult to utilize the space effectively since circuit boards for up- and down-con-

verters have to be separated from each other, and besides, it necessitates lengthy manufacturing steps.

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## SUMMARY OF THE INVENTION

The present invention was made for overcoming the aforementioned problems.

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It is an object of the present invention to provide a more compact tuner in which tuner portions are disposed in an improved manner.

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In order to accomplish this purpose, the present invention provides a television tuner in which a double superheterodyne tuner portion and a BS tuner for demodulating a satellite broadcast signal are housed in a housing for making it possible to provide a compact tuner by thinking out an optimal arrangement.

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Such an arrangement can realize a more compact and integral tuner which is capable of receiving UHF, VHF and satellite broadcasting without lowering the interference characteristics of the up- and down-converter tuner.

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## BRIEF DESCRIPTION OF THE DRAWINGS

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Fig. 1 is a block diagram showing an up- and down-converter tuner;

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Fig. 2 is a block diagram showing a BS second mixer portion of a BS tuner;

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Fig. 3 is a block diagram showing a FM demodulator of the BS tuner;

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Figs. 4A and 4B are block diagrams, each showing an arrangement of a conventional tuner;

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Fig. 5 is a perspective view showing a conventional up- and down-converter coupling portion;

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Fig. 6 is a block diagram showing an embodiment of a television tuner of the present invention;

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Fig. 7 is a block diagram showing an arrangement of the television tuner shown in Fig. 6; and

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Fig. 8 is a plan view showing an up- and down-converter coupling portion in the television tuner shown in Fig. 6.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

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An embodiment of the present invention will be described with reference to the drawings. Fig. 6 is a block diagram showing an embodiment of a system of the present invention for receiving VHF, UHF and satellite broadcasting. Reference numerals 1 through 11, 14, 21, 22 and 25 in Fig. 6 denote like blocks shown in Figs. 1 and 2. Reference numeral 12 denotes an input switching circuit pro-

vided between a RF amplifier 4 and a first mixer 5, 13 denotes an output switching circuit provided between the first mixer 5 and a first IF amplifier 7 and reference numeral 26 denotes a FM demodulator shown in Fig. 3.

An operation of the thus formed receiving system will be described with reference to the block diagram of Fig. 6. The operation of the circuit from a terminal A to a terminal B in Fig. 6 is identical with that in Fig. 1. The first mixer 5, the first local oscillation circuit 6 and the prescaler 14 in the double superheterodyne also work for a BSIF signal which has been inputted from a terminal C as well as a signal from the terminal A. Television signals and BS signals are switched by switching circuits 12 and 13. The BS signal in a 400 MHz band which has passed through the switching circuit 13 is amplified in a BS second IF amplifier 25 and is demodulated in a FM demodulator 26 and is outputted from a terminal D.

The structure of the tuner of the present invention will be described with reference to Figs. 7 and 8.

In Fig. 7, reference numeral 40 denotes an up-converter and a BS second mixer portion for BS signal; 41 denotes an up- and down-converter coupler; 42 denotes a down-converter; 43 denotes FM demodulator; 44 denotes an input terminal for VHF and UHF signals; and 45 denotes a BSIF input terminal. The block 40 comprises components 1 through 7, 12 through 14, 21, 22, and 25 shown in Fig. 6; the block 41 comprises a BPF 8 shown in Fig. 6; the block 42 comprises the components 9 through 11 shown in Fig. 6 and the block 43 comprises the FM demodulator 26 shown in Fig. 6. The block 41 is disposed between the blocks 40 and 42 and the block 43 is disposed in a space surrounded by the blocks 40, 41, and 42.

Referring now to Fig. 8, there is shown the structure of the up- and down-converter coupler 41 comprising a band pass filter 70, a patterned inductor 71 made of a foil of an electrically conductive material, capacitors 72 and 73 and a shield casing 74 functioning as a partition.

A first IF signal which has been inputted from a terminal G will pass through the band pass filter 70 and a low pass filter comprising the patterned inductor 71 and the capacitors 72 and 73 and is then outputted from a terminal H. The band pass filter 70 for passing through the first IF frequency signal and the low pass filter for preventing the leakage of the first local oscillation signal are adapted to couple the up-converter with the down-converter. This block is surrounded by the partition 74 and prevents unwanted signals from passing through a circuit between the input terminal G and the output terminal H.

A tuner which receives VHF, UHF and satellite

broadcasting is made integrally and the up- and down-converters 40 and 41 are disposed so that they are sufficiently separated in position and the up- and down-converter coupler 41 and the FM demodulator 43 may be disposed between the up- and down-converters. Accordingly, spurious radiation due to mutual coupling of local oscillators is prevented. Miniaturization of the tuner may be further accomplished since the FM demodulator may be disposed in a space which is remained by separating up- and down-converters from each other. The up- and down-converter coupler 41 may comprise a combination of a band pass filter and a strip line or a combination of a low pass filter and a strip line. Since both combinations make it possible to provide an elongated link portion which is surrounded by a shielding member, separation between the input and the output is improved and a filtering effect is enhanced.

As mentioned above in accordance with a present invention, a tuner for receiving a television signal is formed as a double superheterodyne system and is made integrally with a tuner for receiving satellite broadcasting. Up- and down-converters of the double superheterodyne are separated from each other and an up- and down-converter coupler and a FM demodulator are disposed therebetween. Two circuit boards need not be separated unlike prior art. A mutual interference between local oscillators may be prevented and a more compact and integral type tuner may be realized and the practical advantages are remarkable.

### Claims

1. A television tuner, including a double superheterodyne tuner means for receiving television signals, having an up-converter (40), a down-converter (42) and a coupling means (41) for coupling said up-converter and down-converter, said television tuner also including a BS second mixer portion (40) and a FM demodulator (43), for receiving signals from a broadcasting satellite, wherein, said double superheterodyne tuner means, said BS second mixer portion and said FM demodulator are disposed in a housing (74), a combination of said up-converter and said BS second mixer portion is undesirably separated from said down-converter, said coupling means is disposed in a space between said combination and said down-converter, and said FM demodulator is disposed in the remaining space of said housing.
2. A television tuner as defined in claim 1, wherein said coupling means comprises a band pass filter for a first intermediate frequency signal and a low pass filter.
3. A television tuner as defined in claim 1, wherein

said coupling means comprises a band pass filter for a first intermediate frequency and a strip line.

4. A television tuner as defined in claim 1, wherein said coupling means comprises a low pass filter and a strip line.

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FIG. 1 PRIOR ART

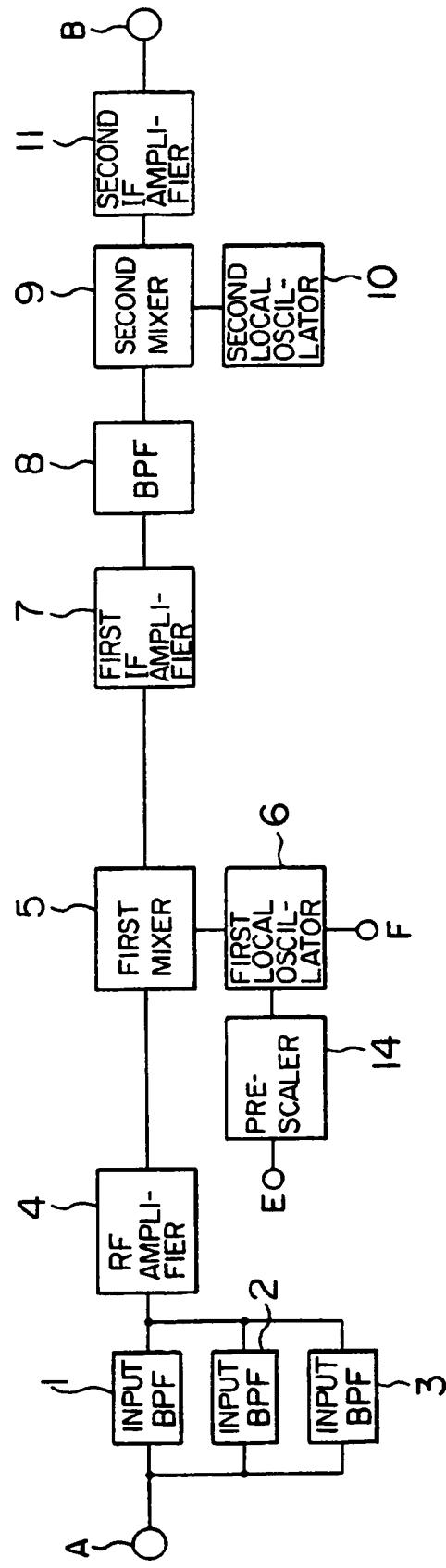


FIG. 2 PRIOR ART

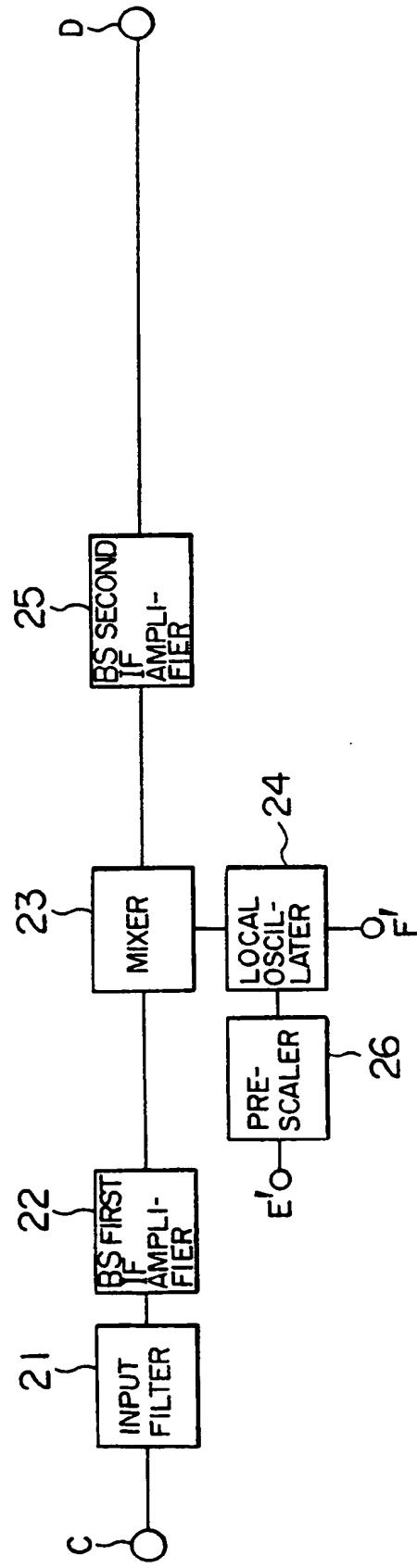


FIG. 3 PRIOR ART

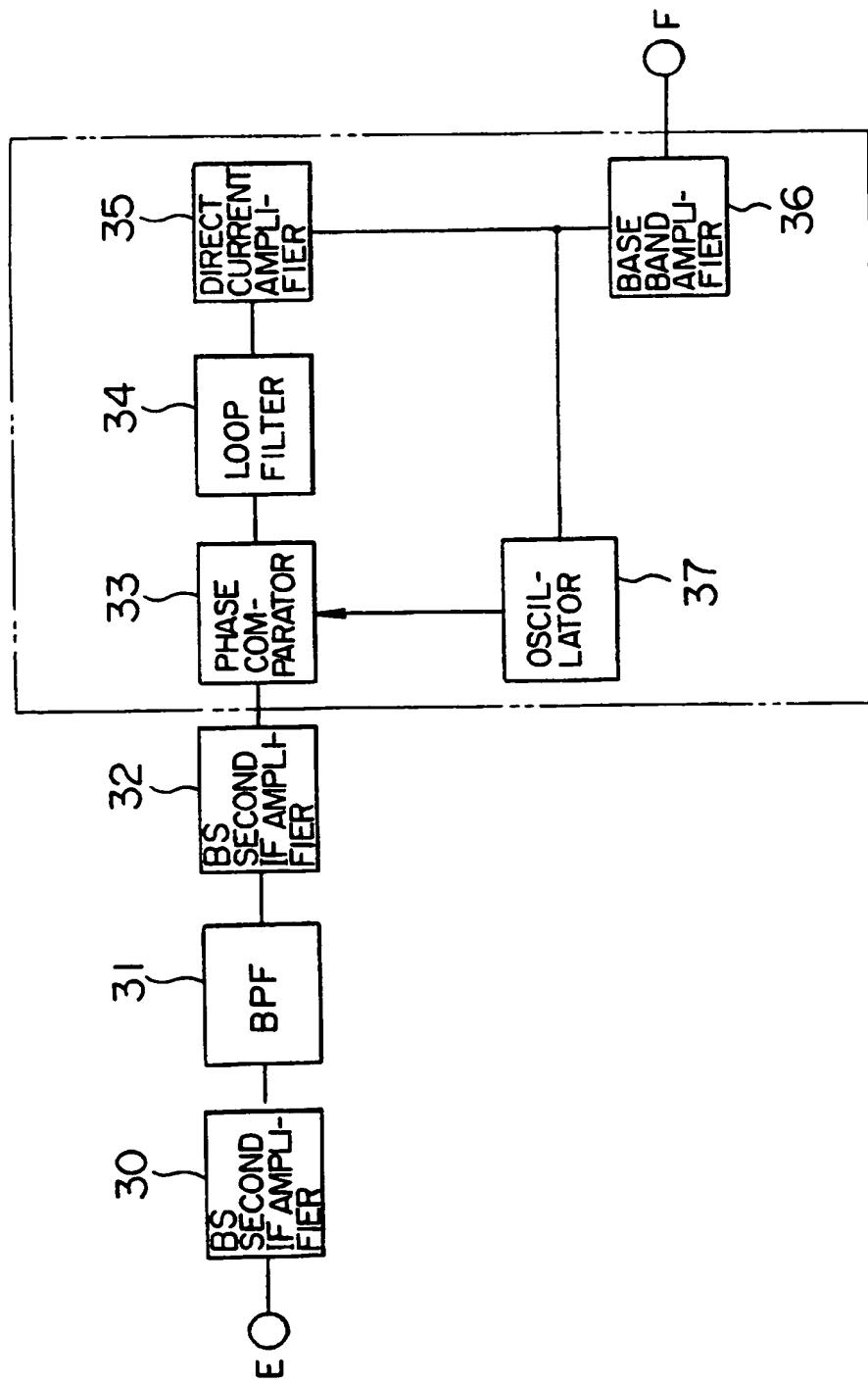


FIG. 4A PRIOR ART

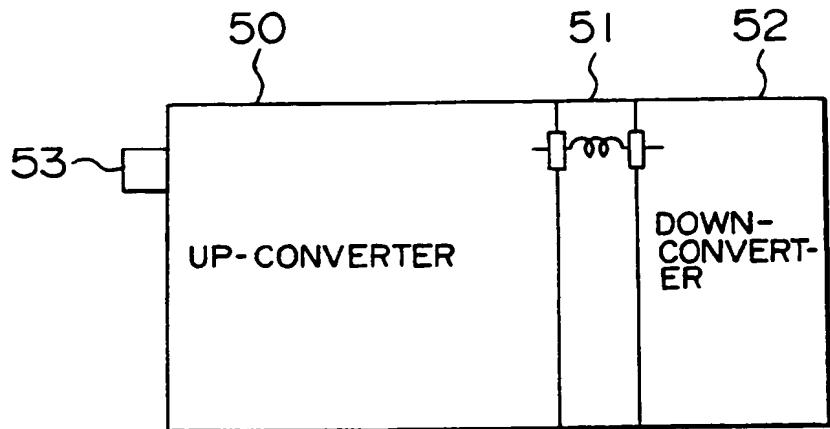


FIG. 4B PRIOR ART

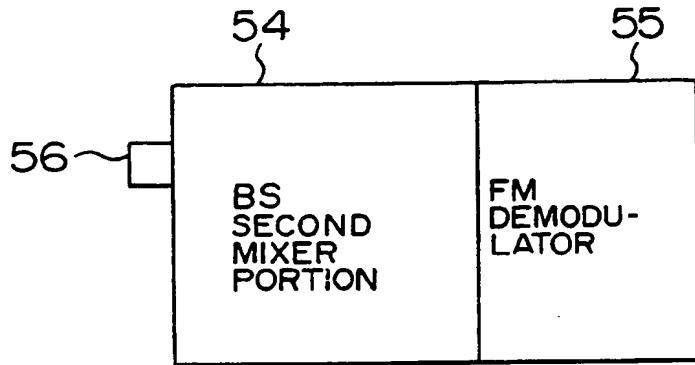


FIG. 5 PRIOR ART

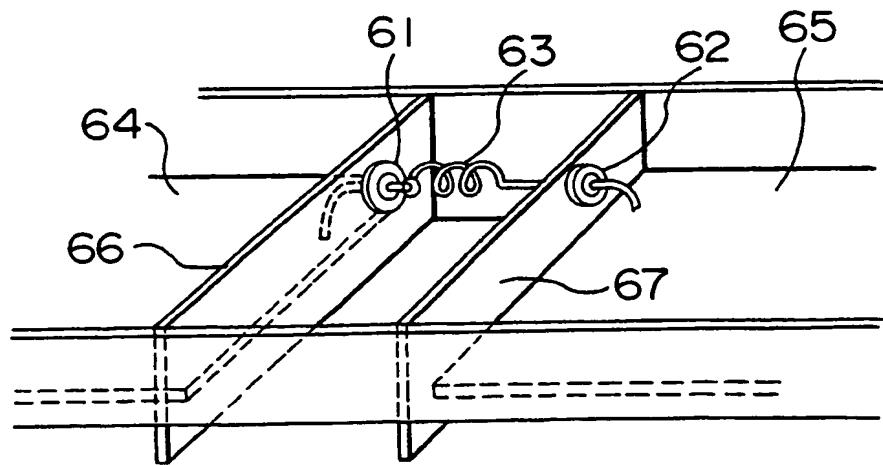


FIG. 6

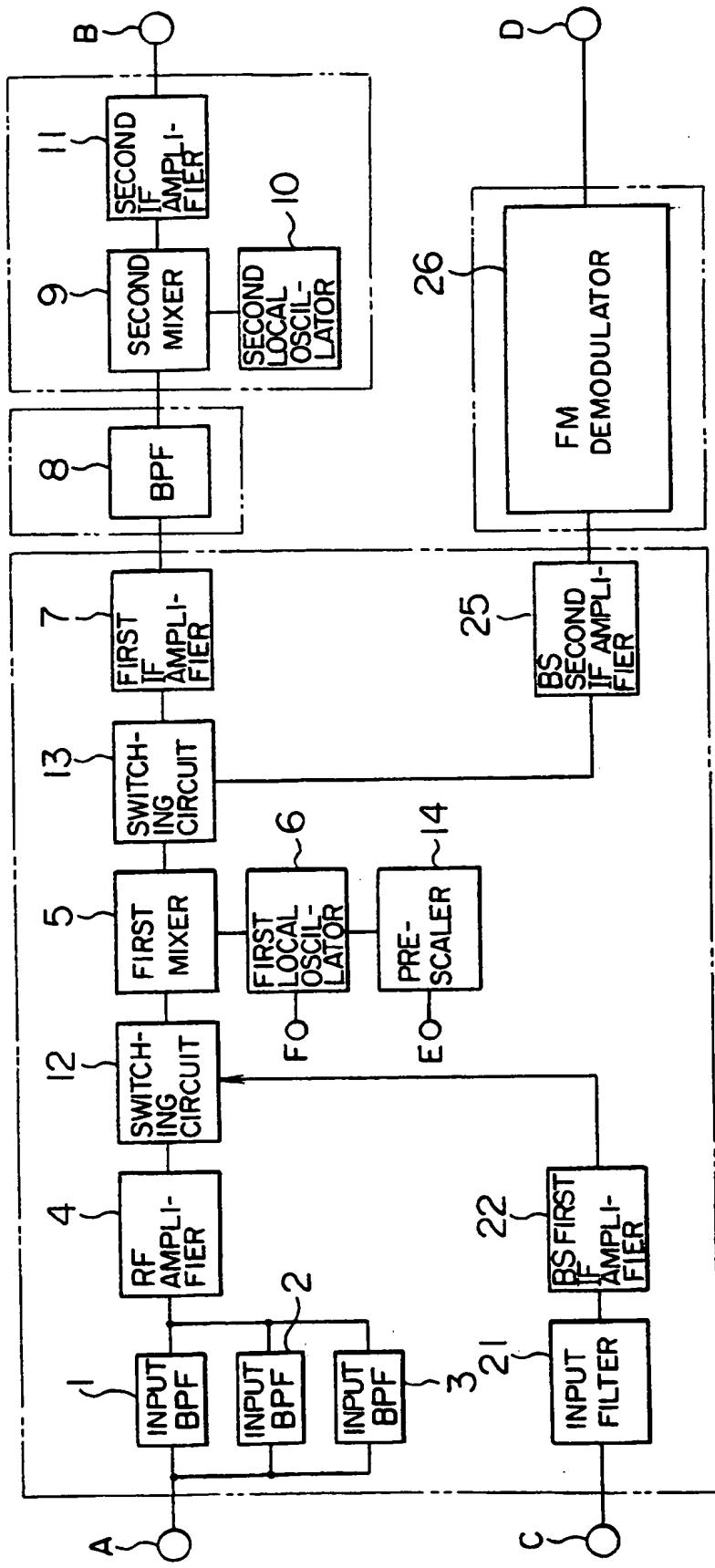


FIG. 7

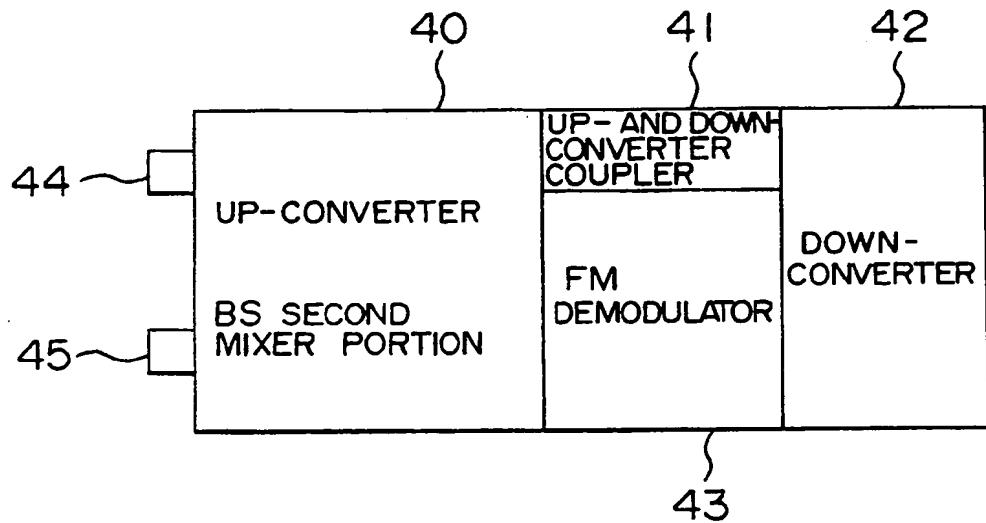
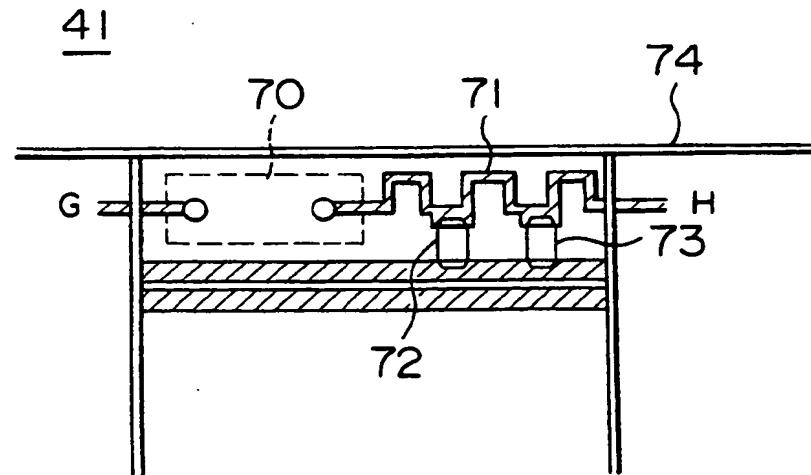
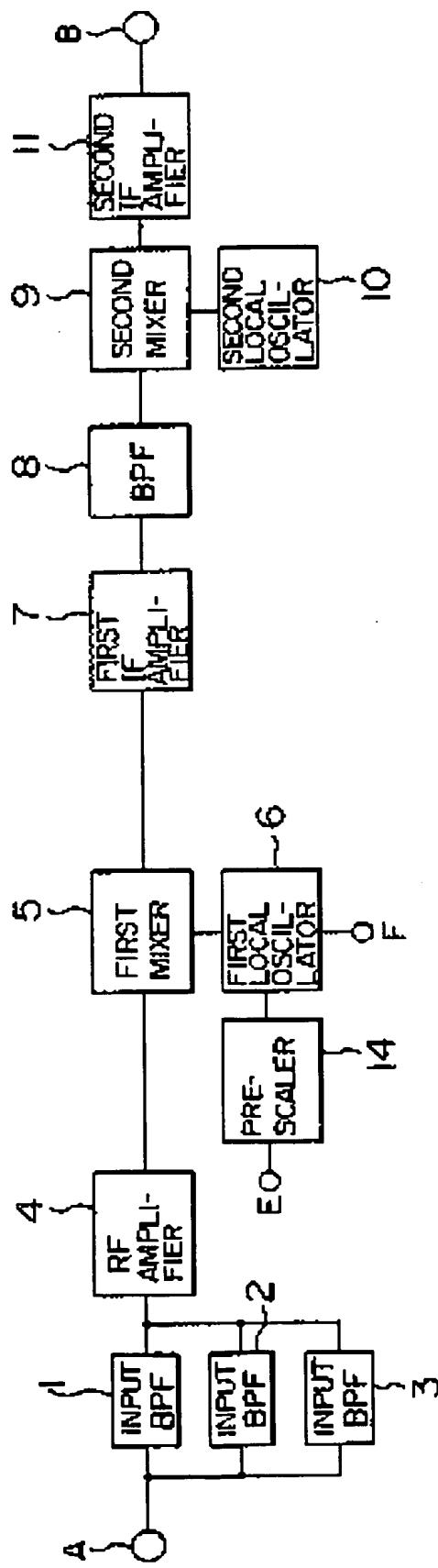


FIG. 8



## FIG. 1. PRIOR ART



## FIG. 2. PRIOR ART

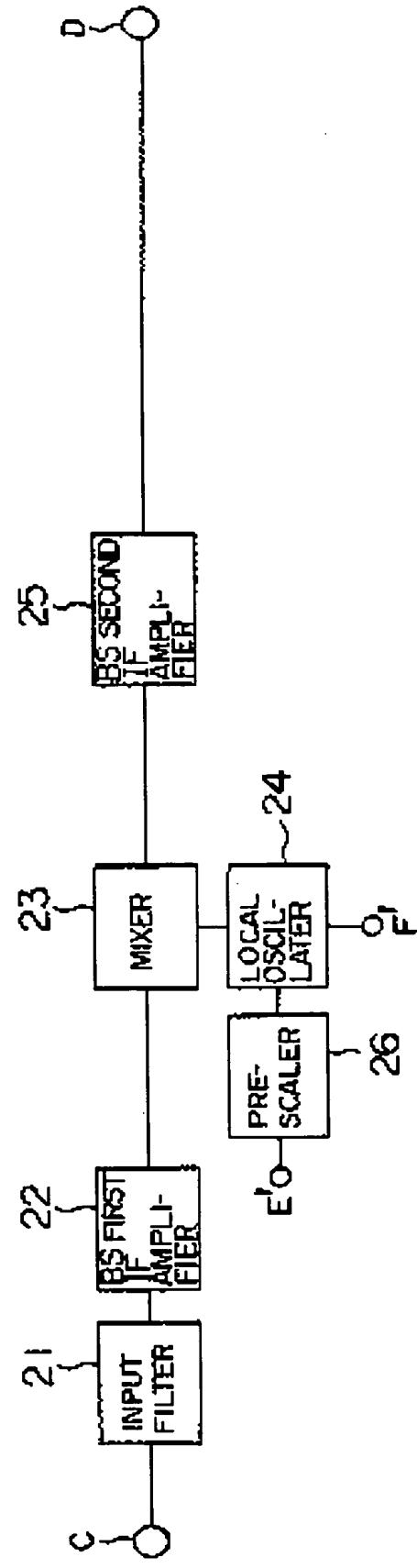


FIG. 3 PRIOR ART

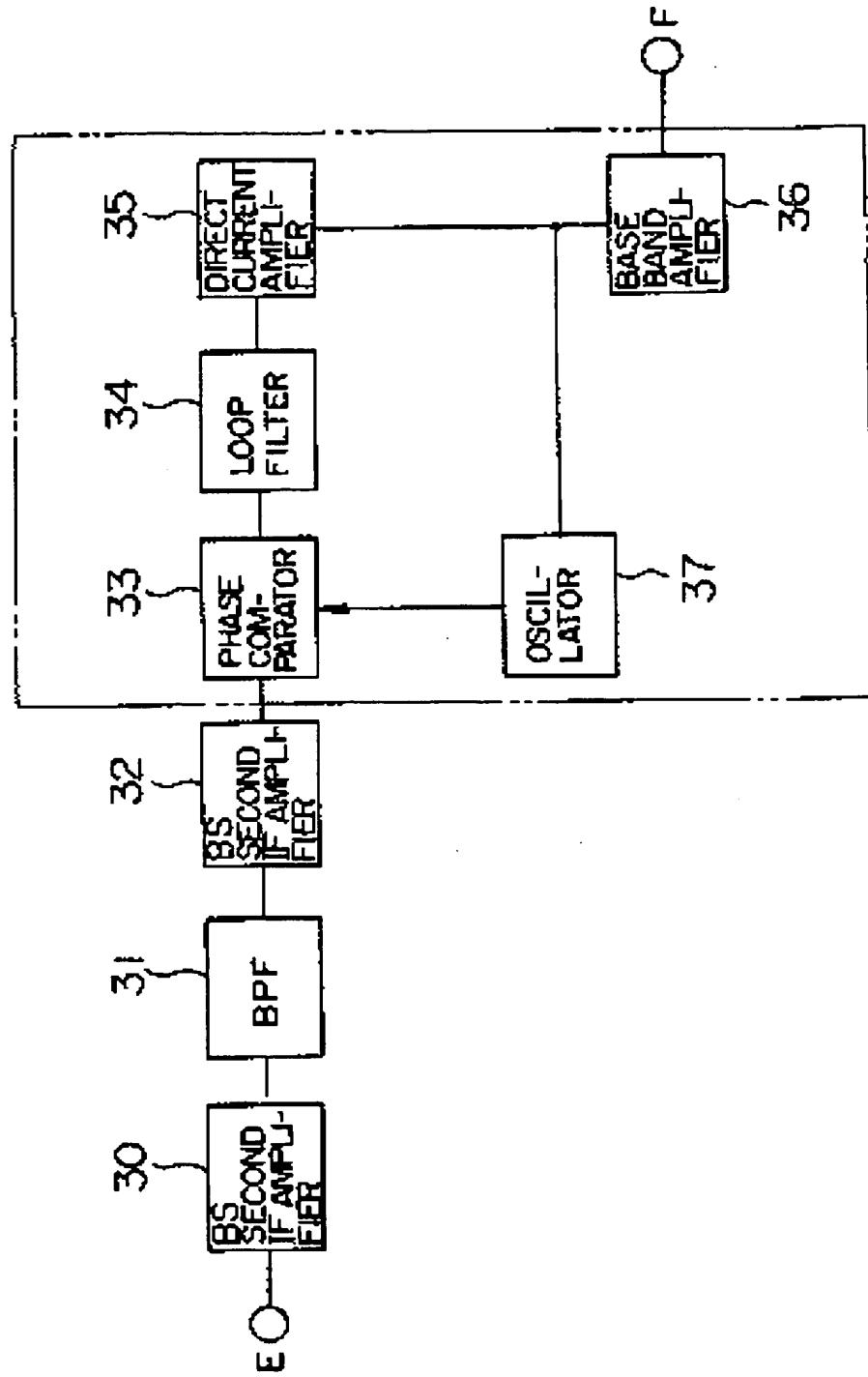


FIG. 4A PRIOR ART

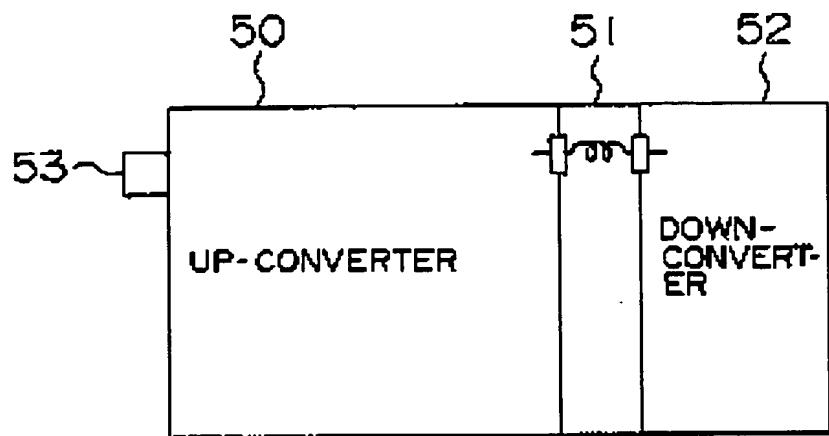


FIG. 4B PRIOR ART

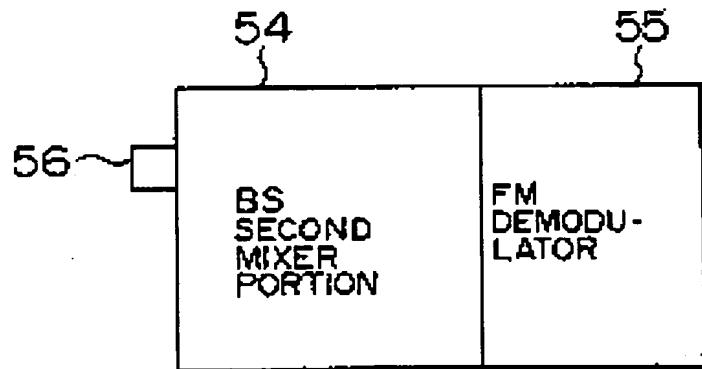


FIG. 5 PRIOR ART

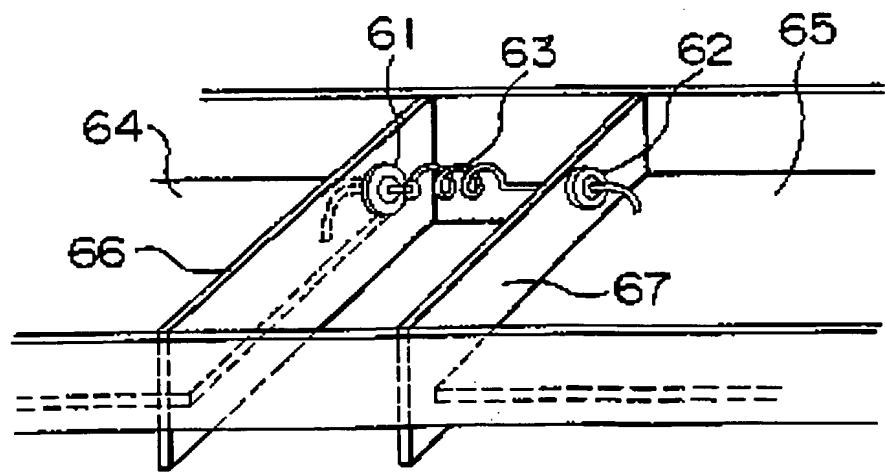


FIG. 6

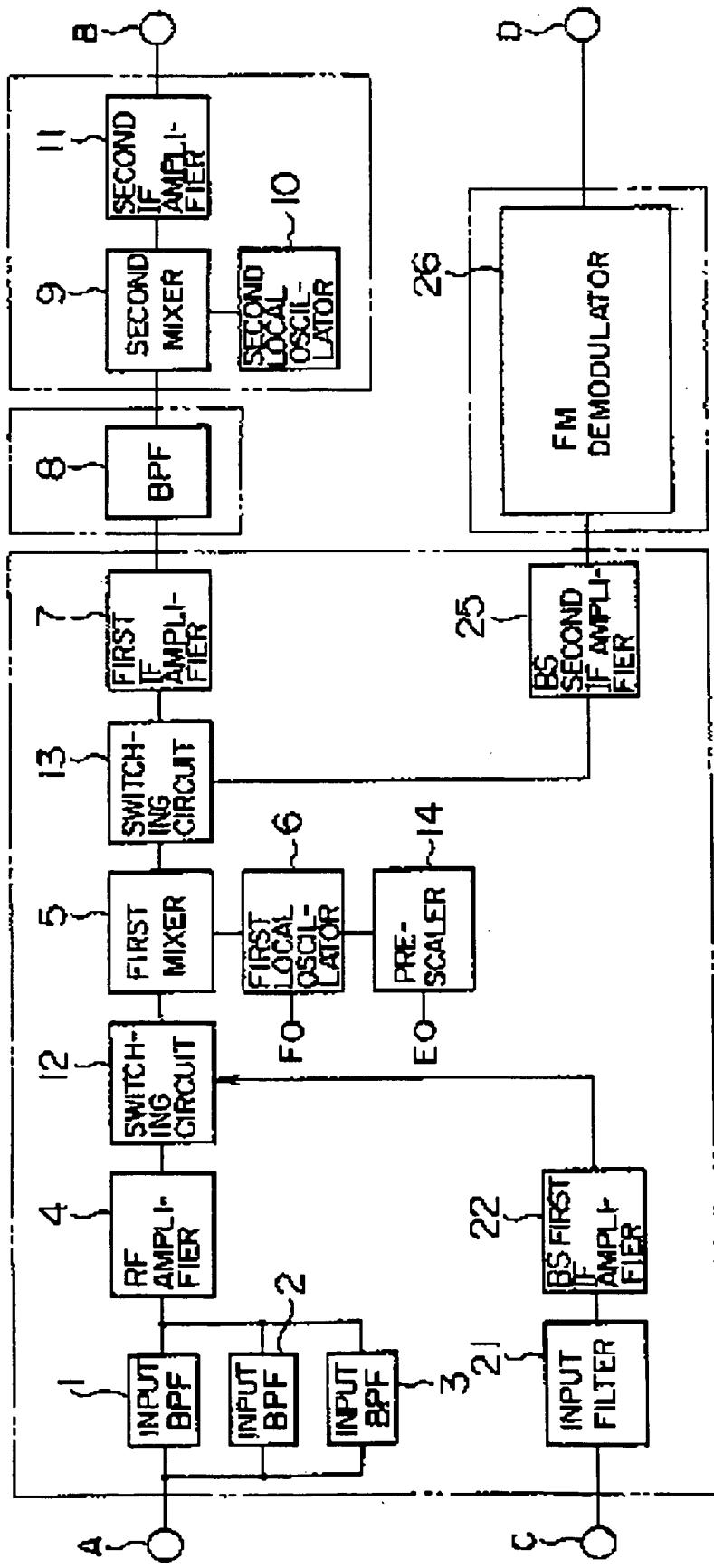


FIG. 7

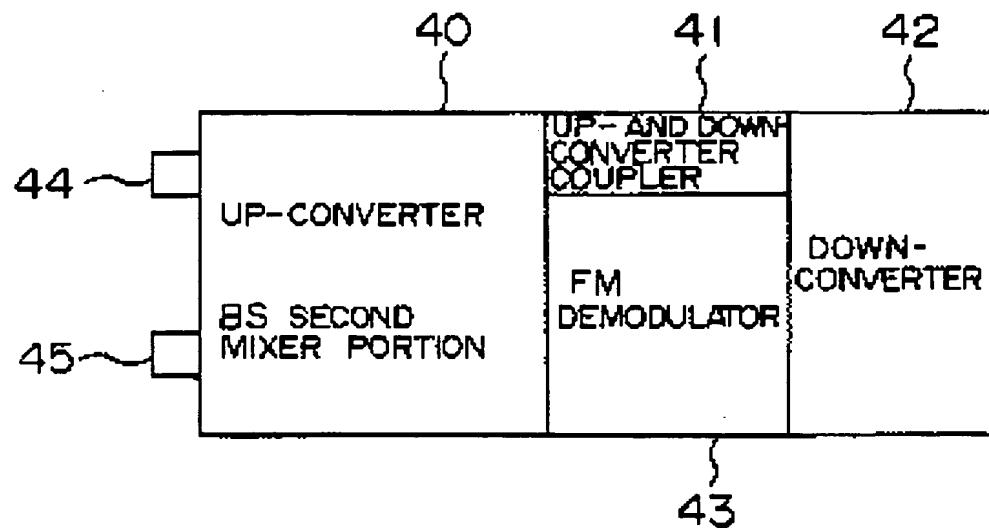
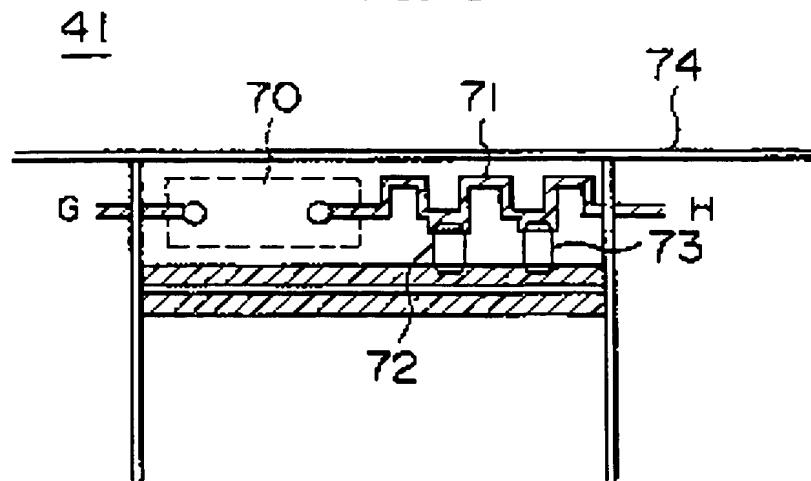


FIG. 8





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## EUROPEAN PATENT APPLICATION

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⑯ **Television tuner.**

⑯ The present invention relates to a television tuner capable of receiving television broadcasting, CATV and satellite broadcasting. The television tuner includes a double superheterodyne tuner for receiving television signals, having an up-converter (40), a down-converter (42) and a coupler (41) for coupling the up-converter and down-converter, and the television tuner also includes a BS second mixer portion (40) and a FM demodulator (43), for receiving signals from a broadcasting satellite. The double superheterodyne tuner, the BS second mixer portion and the FM demodulator are disposed in a housing (74), a combination of the up-converter and the BS second mixer portion is undesirably separated from the down-converter, the coupler is disposed in a space between the combination and the down-converter, and the FM demodulator is disposed in the remaining space of the housing.

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EUROPEAN SEARCH  
REPORT

EP 90 11 3471

DOCUMENTS CONSIDERED TO BE RELEVANT					
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)		
A	US-A-4 569 084 (TAKAHAMA) * abstract; figures 2, 3 ** column 2, lines 10 - 14 ** column 2, line 66 - column 3, line 9 ** column 3, line 58 - column 4, line 16 ** column 6, lines 25 - 51 ** column 7, lines 51 - 65 * - - -	1,2,4	H 03 D 7/16 H 03 J 5/24 H 04 N 5/50		
A	PATENT ABSTRACTS OF JAPAN vol. 8, no. 49 (E-230) 06 March 1984, & JP-A-58 204627 (TOKYO SHIBAURA DENKI) 29 November 1983, * the whole document * - - -	1			
A	DE-A-3 226 980 (SIEMENS) * abstract; figure 3 ** page 5, lines 4 - 27 * - - -	1-3			
A	US-A-4 661 998 (YAMASHITA) * abstract; figures 2, 3 ** column 3, line 40 - column 4, line 32 * - - -	1-3			
P,A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 348 (E-799) 04 August 1989, & JP-A-01 106628 (FUJITSU GENERAL) 24 April 1989, * the whole document * - - - - -	3,4			
TECHNICAL FIELDS SEARCHED (Int. Cl.5)					
			H 03 D 7/00 H 03 J 5/00 H 04 B 1/00 H 04 N 5/00 H 04 N 7/00 H 05 K 9/00		
The present search report has been drawn up for all claims					
Place of search	Date of completion of search	Examiner			
Berlin	10 December 91	JONSSON B F			
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